# CAREER: Resilient Low-Cost Robot Teams for Autonomous Aquatic Exploration

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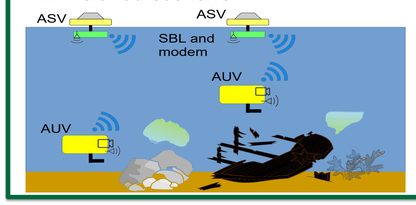
*Envisioned scenario*




Main research goal: develop **algorithms** and **systems** to enable **low-cost** aquatic team of robots to operate in the **wild**

*ASV and AUV exploring*

The main research themes with corresponding unique real-world challenges that are studied in this CAREER are:

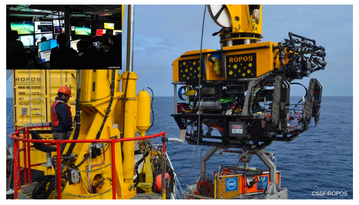
R1 Resilient multi-robot 3D underwater exploration when global localization is missing or highly noisy

R2 Resilient communication under extremely limited communication infrastructure

R3 Graceful recovery to avoid loss of any robot or the whole system in environments with extreme localization and communication limitations

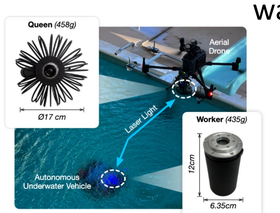
with low-cost robots, that have limited computational, perception, and motion capabilities.

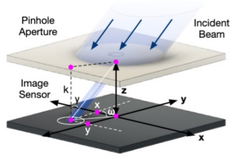
*Expensive aquatic robots and deployments hinder their broader use*



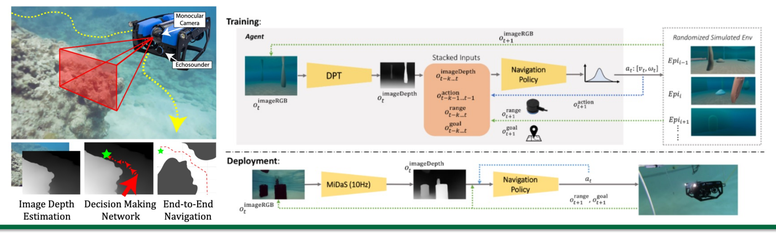
Some of the current contributions include:

Localization underwater through laser between air-water [1]

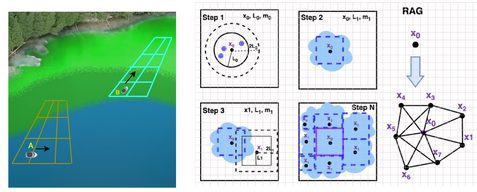



Multi-sensor fusion for underwater navigation [2]




Non-stationary spatial field multi-robot active learning [3]




Scientific impacts are in several areas of robot autonomy for inexpensive robots, through computational methods and systems, advancing robots robustness in:

1. Localization
2. 3D exploration
3. Coordination

that can generalize for any system in constrained real-world environments.

*Robots under ice*

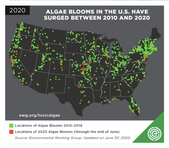
*Robots in caves*



Broader societal impacts include:

1. Democratize aquatic robots
2. Apply and broaden the use of the robotics technology for high-impact applications, with specific activities, such as lake monitoring for climate change

*Inexpensive robot built in the lab*




*Algal bloom*

Robots have been used to achieve education objective in:

- K-12 outreach,
- lake associations,
- education beyond computer science

*Outreach activities from the lab*

## References

[1] Carver, C. J., Shao, Q., Lensgraf, S., Sniffen, A., Perroni-Scharf, M., Gallant, H., Quattrini Li, A. & Zhou, X. (2022, June). Sunflower: locating underwater robots from the air. In Proceedings of the 20th Annual International Conference on Mobile Systems, Applications and Services (MobiSys).

[2] Yang, P., Liu, H., Roznere, M., & Quattrini Li, A. (2023). Monocular Camera and Single-Beam Sonar-Based Underwater Collision-Free Navigation with Domain Randomization. In International Symposium of Robotics Research (ISRR).

[3] Masaba, K. & Quattrini Li, A. (2023). Double blind. (under review).

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